DOCUMENT RESUME

ED 148 635 SE 023 787

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TITLE Differences Between Teachers' Attitudinal Self-Ratings and Their Principals' Teacher Ideal on a Mathematics Inventory. Research Paper No. 14.
INSTITUTION Minnesota Univ., Minneapolis. Coll. of Education.
SPONS AGENCY National Science Foundation, Washington, D.C.
PUB DATE 30 Dec 74
GRANT NSF-GW-6800
NOTE 17p.; For related documents, see SE 023 784-792

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Educational Research; *Mathematics; *Principals; Secondary Education; Secondary School Mathematics; *Teacher Attitudes; *Teachers
IDENTIFIERS Minnesota Research and Evaluation Project; National Science Foundation; *Research Reports

ABSTRACT

One hundred forty-eight secondary school principals were chosen at random and asked to select one teacher at random from the mathematics faculty of their schools. Both were administered the Mathematics Inventory for Teachers, an instrument designed to measure attitudes toward mathematics as a subject and toward its teaching. The principals were asked to respond as they believed an ideal mathematics teacher would, while the teachers were asked to express their own beliefs and opinions. The results were factor analyzed, and the principals and teachers differed in two of the eight factors. It appears that teachers are not as responsive to student needs as their principals would have them be. The principals would have their teachers give more attention to students who are having difficulty learning the subject. In addition, the principals' responses showed a more narrow, conservative conception of the function of mathematics instruction while the teachers were more cognizant of the need for higher order outcomes in mathematics. (BB)

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SE 023 787

RESEARCH PAPER #14

Differences Between Teachers' Attitudinal Self-Ratings and Their Principals' Teacher Ideal on a Mathematics Inventory

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and Victor L. Willson
University of Minnesota
December 30, 1974

This study was supported by Grant GW-6800 from the National Science Foundation to the University of Minnesota; Wayne W. Welch, Project Director.

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This study was conducted to examine differences between mathematics teachers' self-ratings and their principals' "idealized" mathematics instructors on an inventory concerned with both the cognitive and affective outcomes of mathematics instruction. Individual items on the instrument were aggregated using factor analytic techniques into seven scales related to the teaching and learning of mathematics. Scale scores were compared using analysis of variance procedures.

Related Research

Research comparing principal and teacher perceptions of the various dimensions of the in-school experience is sparse. An ERIC search conducted for this study did not generate a single research paper which specifically contrasted principal and teacher attitudes and/or perceptions. In a recent related study, Reineke and Welch (1973) examined the degree of heterophily (differences between individuals or groups of individuals) existing between principals and teachers regarding the perceived adequacy of school conditions. Results indicate that of the five dimensions examined (teacher effectiveness, teaching load, curriculum, facilities, and support staff) teaching effectiveness was considered most adequate among both groups. Their data also suggest that principals view conditions in their own schools considerably more favorably than do teachers. One of two possible explanations were suggested: (1) persons tend to view more favorably those conditions over which they have direct control (locus of control considerations) or (2) principals and teachers have become

distinct groups through their selection, specialization of function, and professional interests, and that effective communication between them is lacking.

The study described herein is related in that principals' and teachers' attitudes and perceptions were again compared, this time as they relate specifically to the discipline of mathematics and its teaching. The identification of perceptual discrepancies between teachers and principals would appear to be an important first step in improving the educational environment of our schools.

Method

Principals in this study were selected randomly as part of an NSF grant to study change in selected regions of the country (see Welch and Gullickson, 1973). Stratifying variables were grade level (8th and 11th), urban and rural location, and subject matter (mathematics and science). Principals in California, Michigan, and Indiana were selected for the mathematics assessment. The principals selected one teacher at random from the mathematics faculty of his school. Both subsequently completed a battery of instruments. Among these was the Mathematics Inventory for Teachers (MIT) comprised of 30 items. Items on the MIT were taken from or were similar to items developed for the NLSMA (NLSMA Report 1968) or the International Study of Achievement in Mathematics (1967). The MIT assembled by Bracht (1972) contains statements concerning educational ideas and practices specifically dealing with the teaching and learning of mathematics in the secondary school. The items assess attitudes both toward mathematics as a subject and toward its teaching. It purports to let the respondent "express their beliefs and opinions." Each item is followed by the numerals 1 through 4 which correspond to: Strongly Agree, Agree, Disagree, and Strongly Disagree, respectively. Respondents are

asked to circle the numeral which most closely corresponds to their reaction to the item statement. Principals were asked to respond to the MIT as they believed an ideal mathematics teacher should, while the randomly selected teachers were asked to express their own beliefs and opinions. A total of 148 teacher-principal pairs responded to this instrument.

The MIT originally was constructed to consist of five attitudinal subscales: mathematics as a process; classroom management practices; interest in teaching mathematics; rating of teaching practices; and rating of teacher concern for students. Both logical examination and inspection of scale coefficient alpha reliabilities convinced the authors that subscales were inadequate as constructed. The MIT was subjected to principal components analysis to extract new scales. Teachers' responses were used for the analysis, since they represent actual attitudes.

Eight factors were extracted from the principal components solution and were rotated using a varimax solution. The eight factors were examined for logical organization. Only items loading higher than .3 on the rotated solution were included in the factors. Of the eight, the first seven were conceptually identifiable. The last factor was considered to be a random factor.

Principal components was chosen as the factoring procedure, since the factor scores would be easily interpretable. A common factors solution with R^2 as the communality estimate was examined, however, to see if the structure had stability. Eight factors were identified and rotated. The resulting structure was quite similar. (One factor split into two, but the factors were identifiable.)

The factors produced by the principal components rotated solution are identified and discussed below:

Factor 1 --

Scale items loading heavily on Factor 1 relate to a flexible perspective of both the teaching and learning of mathematics. Persons scoring high on this factor should in their teaching tend to use a variety of instructional modes, as well as actively promote multiple approaches to the solution of mathematical problems. For these reasons, we have labeled Factor 1: FLEXIBILITY.

Factor 2 --

This factor centers around an interest and concern for the non-cognitive outcomes of mathematics teaching. It would appear also to include a recognition of the importance of the process dimension of effective mathematics learning. A high score on Factor 2 implies conscious attention to the development of positive student attitudes and an inherent belief that "mathematics is not a spectator sport." Factor 2 has been labeled: MATHEMATICS AS PROCESS.

Factor 3 --

MIT components clustering on this factor all relate to teachers' concern for student. A high factor score implies a strong professional commitment to the improvement of student achievement in mathematics and a willingness to provide additional instructional assistance when required. Factor 3 is labeled: TEACHER CONCERN FOR STUDENT.

Factor 4 --

Factor 4 is composed of items which relate primarily to the teachers' vocational satisfaction. Concern for the development of a productive learning environment is also a component. It should be noted that one item also loads significantly on Factor 2. This implies that various factors resulting from this analysis are not completely independent. Factor 4 is labeled: VOCATIONAL SATISFACTION.

Factor 5 --

MIT items loading on this factor generally are concerned with the development of precisely determined mathematical skills and are indicative of a more traditional and, certainly, a more conservative view of mathematics learning and teaching. Persons scoring high on Factor 5 have, at the very least, expressed an awareness of the existence of higher order teaching and learning objectives in the mathematics classroom. Two items load significantly on other factors. Factor 5 is labeled: NON-RIGID PRACTICES.

Factor 6 --

Labeled ATTITUDE TOWARD TEACHING, Factor 6 contains items conceptually related to those found loading on Factor 4, Vocational Satisfaction. This factor is not well defined and is considered to be one of the "weaker" factors resulting from this analysis.

Factor 7 --

Similar to Factor 5, Non-Rigid Practices, the five MIT items loading on Factor 7 are related to a concern for rules and precisely determined outcomes. Two of the three items, which also load significantly on other factors, load on Factor 5. As was the case with Factor 5, persons scoring high on this factor have indicated disagreement with the positions stated. If translated into action, such disagreement would imply behaviors more consistent with the contemporary view as to appropriate objectives for mathematics learnings--that is, a recognition of the importance of higher order objectives. Factor 7 is labeled: HIGHER-ORDER CONCERNS.

Factor 8 --

Items loading on Factor 8 do not, in the opinion of the investigators, fall within a discernible conceptual framework. No attempt has been made, therefore, to either label or interpret this factor.

The actual MIT items comprising the various factors are available from the Minnesota Research and Evaluation Project.

Analysis Procedures

Scales were constructed from the seven factors using the procedure discussed by Harman (1967, p. 349). Scale reliabilities were estimated by weighing individual item scores by their corresponding varimax loadings. This procedure generates a conservative estimate of the true reliability coefficients. Subsequently, coefficient alpha was computed for the weighted responses, as noted by Armor (1974). These reliabilities and scale intercorrelations are given in Table 1.

Factor scale scores were computed for the principals' idealizations using the loadings observed for teachers' self-ratings. Under a null hypothesis of no difference between the principals' idealization and teachers' actual self-ratings, the scale scores computed this way should be expected to differ only randomly between teachers and principals.

Difference scores between each principal-teacher pair were analyzed with a seven dependent variable multivariate analysis of variance. Grade level (8 and 11) and region (California and Indiana-Michigan) were included as independent crossing variables. The primary test of interest is the test of the grand mean vector of differences, to see if it is non-zero in a multivariate sense. If so, univariate F-tests on the individual means will help to locate the differences.

Results

The multivariate analysis of variance was performed utilizing a program due to Finn (1970). The grand mean vector of differences was significantly different from zero in a multivariate sense at $p = .10$. Grade level, location,

TABLE 1

Reliabilities and Intercorrelations For Seven Scales Derived From The Mathematics Inventory for Teachers

	Flexibility	Math as Process	Teacher Concern	Voc Sat	Non-Rigid	Attde Teach	Higher Order
Flexibility	.57						
Mathematics as Process	.19	.51					
Teacher Concern	-.32	-.12	.49				
Vocational Satisfaction	.30	.33	-.22	.64			
Non-Rigid Practices	-.20	-.15	.29	-.16	.65		
Attitude Toward Teaching	-.20	-.01	.15	-.04	.09	.51	
Higher Order Concerns	-.05	-.29	.11	-.15	.47	.06	.57

Scale reliabilities are underlined on the diagonal.

and the grade by location interaction were not significant at p = .10. Multivariate F-statistics for the grand mean and effects are given in Table 2, along with the univariate F-statistics for the grand mean.

Of the seven dependent variables, F-statistics for two were significantly different from zero, indicating principals and teachers produced different scores on Factor 3--Concern for Students, and Factor 7--Higher-Order Concerns.

Discussion Factor 3: Teacher Concern For Students

The greatest disparity between principal and teacher scores was noted in Factor 3, Teacher Concern For Students. The significantly higher principal scores (recall that principals were asked to respond as they felt the ideal mathematics teacher would) implies that teachers, in general, are not as responsive to student needs, especially in the remediative sense, as their administrators would have them be. One can only speculate as to the underlying variables inherent in the observed discrepancy. Regardless of the reasons involved, however, it would seem that principals would have their teachers give more attention to those students who are having difficulty learning the subject. The data do not suggest that teachers are unaware of the importance of this function, nor do they suggest that teachers are wholly negligent, insofar as providing additional assistance to those in need is concerned. They do, however, suggest that, from an administrator's point of view, additional teacher efforts should be expended if all students are to maximize their individual potential.

One might also infer from the observed differences on Factor 3 scores that, from the principal's viewpoint, a disproportionate share of the teachers' attention is focused on those students at or above the acceptable level of mathematics achievement. If true, then pedagogical priorities need t⁄ be

TABLE 2

Summary Table For Multivariate and Univariate
F-Statistics For Analysis of Difference Scores
Between Principals and Teachers on Seven Scale Scores

Multivariate Tests

Source of Variation	df_{source}	df_{error}	F-Statistic	Probability of Occurrence
Grand Mean	7	138	5.98	<.01
Grade	7	138	.65	<.71
State	7	138	.31	<.95
Grade x State	7	138	1.55	<.16

Univariate Tests for Grand Mean

$df_{Grand\ Mean} = 1$ $df_{error} = 144$

Variable (Factor)	$MS_{Grand\ Mean}$	MS_{error}	F-Statistic	Probability of Occurrence
1. Flexibility	.872	.523	1.67	.20
2. Mathematics as Process	.205	.513	.40	.53
3. Teacher Concern	12.54	.543	23.09	.01
4. Vocational Satisfaction	.059	.627	.09	.76
5. Non-Rigid Practices	.0003	.746	.0004	.99
6. Attitude Toward Teaching	1.65	.728	2.27	.14
7. Higher Order Concerns	2.37	.713	3.33	.07

reassessed and/or redefined within the local setting. Such reassessment would inevitably lead to increased communication between principals and teachers. This should be beneficial to all concerned.

Discussion Factor 7: Higher Order

As can be seen from Table 2, the Principal-Teacher weighted scores on Factor 7 were also significantly different from zero. Three of the five MIT items within Factor 7 also load significantly on other factors. A low score on Factor 7 implies a narrow conception of the role and function of mathematics instruction, as well as a limited perspective as to the nature of the appropriate objectives. Principals scored lower on this scale, suggesting that teachers are more cognizant of the need for higher order outcomes in mathematics. Teachers expressed a greater degree of disagreement with MIT items loading significantly on Factor 7, which incidentally were negatively stated (i.e., strong disagreement implies a desirable viewpoint). Such disagreement is more in keeping with a "progressive" view and implies a recognition of the existence of a level of mathematics learning and achievement which transcends mere computational proficiency and direct applicability to everyday experiences. This outcome is not surprising since teachers have received more specialized training in both the subject and its pedagogy and should be more knowledgeable regarding such matters.

The more "conservative" position espoused by principals is also understandable. As the primary liaison between school and community and between school and district administrative offices, the principal is generally the first to be "held accountable" for student achievement within the school mathematics program and on standardized achievement tests. Among other things, standardized instruments often compare schools within districts, as well as

individual mean school achievement to national norms. At best, such instruments rarely assess higher order objectives accurately and, at worst, assess no more than computational facility and other related student-conditioned responses. To the non-mathematics or non-science-oriented person who has, in all probability, received a relatively limited exposure to higher order mathematics learning objectives, it is conceivable that the negatively stated MIT items accurately depict the essence of the types of learnings measured by such tests and those stressed by many school mathematics programs. This, in the opinion of the writers, is unfortunately a relatively accurate assessment. This discussion is not meant to imply that such lower level objectives are not important. It is, however, felt that they must be kept within an appropriate perspective--that is, they are felt to be necessary but not sufficient.

Further, and perhaps a bit more disturbing (although understandable), such persons, because of their experiences with the subject, would tend to actually believe that Factor 7 items as stated depict both an acceptable approach to mathematics instruction and an appropriate description of its major objectives.

Concluding Remarks

As indicated, weighted difference scores (Principal minus Teachers) were significantly different from zero in two of the seven identifiable factors. It is perhaps significant that such differences were not exhibited in more instances, given the fact that principals were asked to respond as their "ideal" mathematics teacher would, and teachers were asked to express their own beliefs and opinions. Lack of significant differences on five of seven factors is probably due to one of two reasons: Either the power of the test

is insufficient to discriminate between the two groups on the five variables, or there is general agreement among administrators and the mathematics teachers employed in their respective schools. If one assumes that teachers do, in fact, conduct mathematics classes in a manner consistent with their philosophical outlook, it follows that principals are generally satisfied with mathematics programs as they currently exist. The following comments are based on that assumption. Specifically, principals:

1. Agree that teachers exhibit an appropriate degree of classroom flexibility with respect to the pedagogical methods employed. (This statement results from no significant differences on Factor 1)
2. Are in accord with the degree of attention paid to the process outcomes (attitudes, interests, and the development of general problem solving techniques) of mathematics instruction. (This statement results from no significant differences on Factor 2)
3. Believe that teachers are satisfied with their vocational choice. (This statement results from no significant differences on Factor 4)
4. Are in agreement as to the amount of time and effort expended to promote student mastery of highly specific mathematical rules, skills, and procedures. (This statement results from no significant differences on Factor 5)

It is unlikely, in light of the degree of satisfaction indicated above, that suggestions for substantive modifications of existing mathematics curricula from sources outside the school would be well received. If true, this would ultimately prove to be a major impediment to curricular innovation and may, in fact, account for the agonizingly slow pace with which new and significantly different curricular materials, objectives, and instructional

procedures are accepted and implemented within the school setting. Studies are needed to determine the degree of difference between the perspectives of school personnel (changees) and university professors (change initiators) as these perspectives relate to the appropriate nature of the teaching and learning of mathematics. Should large scale differences exist, further light would be shed on the nature and difficulties inherent in promotion of mathematics curricular innovation. Such studies are currently projected by the Minnesota Research and Evaluation Project (MREP).

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